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Performance of Broilers Fed Barley-Based Diets Supplemented by Two Sourses of Commercial Probiotics

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Abstract: To evaluate effects of dietary probiotic supplementation on performance of broiler chicks fed barley-soybean meal-based diets, 360 one-day old Ross broiler chicks with the same number of both sexes were utilized for a 49-day experimental period. The chicks were randomly allocated to 36 pens containing 10 chicks each with six replicates and assigned to receive one of the six experimental diets. Based on a 3×2 factorial arrangement of treatment, six iso-caloric and iso-nitrogenous diets including two Iranian barley cultivars (Sarurood-1, a rain-fall cultivar and Karoon-dar-Kavir, an irrigated cultivar) and commercial probitics (Biosaf®, *Saccharomyces cerevisiae* and Bioplus 2B®, *Bacillus subtilis* and *Bacillus licheniformis* and a control group, with no supplemental probiotic) were formulated. A commercial dietary enzyme (Safizyme® GP 800) with β-glucanase activity was added to all six experimental groups. Dietary treatment did have no significant effect on BW, BW gain and FCR of birds (P>0.05). The used commercial probiotics had no beneficial effects on body weight gain (P>0.05). Birds fed Sarurood-1-included diet consumed more feed than the chicks fed Karoon-dar-kavir-included diets (P<0.05). The used commercial probiotic decreased FI of chicks compared to the control group during the finishing period (P<0.05). It can be concluded that probitics may improve the efficiency of feed. In addition, dietary barley varieties can have influence on feed intake.

Key words: Probitic · Saccharomyces cerevisiae · Bacillus subtilis · Bacillus licheniformis · Barley cultivar · Performance · Broilers

INTRODUCTION

Because of the high cost of corn, the use of locally grown barley and wheat in broiler diets has become more appealing in Iran. Barley is the cereal most extensively used for animal feeding because of its adaptation to dry climates and hardiness. However, its use for poultry, mainly broiler chicks, has been traditionally restricted due to low energy value and associated problems such as sticky dropping [1]. Barley contains ß-glucan as the major anti-nutritional factor in the cell wall of the aleurone and endosperm layers. These non-starch polysaccharides (NSP) are ß-1,4 or ß-1,3 glucosidic linked and not hydrolyzed by digestive enzyme in birds [2]. Since water soluble barley ß-glucan forms viscous solutions and cannot be completely hydrolyzed in the gastrointestinal tract of the broiler chickens, it has been shown that feeding of barley-based diets to chickens will increase gastrointestinal viscosity [3-4]. The increase in gastrointestinal viscosity can cause reductions in growth rate and nutrient absorption [5]. Experiments on the metabolizable energy suggest a considerable variation in ME between different barley cultivars. In addition, substantial variation exists in other feed quality-related characters in barley [6]. Extensive work has been done to study the effect of dietary enzyme supplement on the energy value of barley [7-9], as well as growth performance and nutrient digestion [10-14]. However, the expenses of dietary enzyme supplementation are high. The use of probiotics with high activity of specific enzymes provides additional benefits in terms of reducing the cost of enzyme supplementation.

Probiotics are used to develop and maintain a healthy intestinal microflora in young animals. In addition, contemporary bio-security threats arising from the increasing resistance of pathogens to antibiotics and the accumulation of antibiotic residues in animal products and the environment elicit a call for a worldwide antimicrobial growth promoters ban. A growing body of scientific research supports the role of probiotics as effective antibiotic alternatives in animal nutrition [15, 16]. The most common probiotics are live bacteria or yeast used as

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feed supplements. Bacteria frequently used as probiotics in poultry production include species of *Bacillus*, *Bifidobacterium*, *Enterococcus*, *Escherichia*, *Lactobacillus*, *Lactococcus* and *Streptococcus*. Among these, nonpathogenic *Bacillus* spp. have been extensively studied and widely employed in many commercial applications [17]. Spores of *Bacillus cereus, Bacillus subtilis* and *Bacillus clausii* have been used as probiotics in animals and humans. Strains of *B. subtilis* have been selected as candidate probiotics on the basis of their in vitro inhibitory effect on avian pathogenic *Escherichia coli* or *Clostridium perfringens* [18]. Beneficial effects of probiotics on broiler i) performance [19-21], ii) nutrient digestibility [21, 22], iii) modulation of intestinal microflora [19, 22-24], iv) pathogen inhibition [25-28] and v) immunomodulation and gut mucosal immunity [29-30] have been reported. During the last decades *Saccharomyces cerevisiae* yeast cell wall components have been used in animal feeding to improve productivity, which was attributed to physiological effects on intestinal digestive mucosa [31-35].

Research on nutritive value of various Iranian barley cultivars is rare. In addition, no study has been down evaluating any probable interaction between dietary barley cultivar and probiotic on productive performance of broiler chicks. The present study was conducted to evaluate the potential for two sources of commercial probiotics in barley-based diets and evaluate any interaction between dietary barley cultivar and probiotic on broiler performance.

MATERIALS AND METHODS

Three hundred and sixty one-day old Ross broiler chicks were used as a 49-day long experimental period. The chicks were randomly allocated to 36 pens containing 10 chicks each with 6 replicates and assigned to receive one the six dietary treatments. Based on a 3×2 factorial arrangement of treatment, six iso-caloric and iso-nitrogenous diets including two Iranian barley cultivars (Sarurood-1, a rain-fall cultivar and Karoon-dar-Kavir, an irrigated cultivar) and commercial probitics (Biosaf®, *Saccharomyces cerevisiae* and Bioplus 2B®, *Bacillus subtilis* and *Bacillus licheniformis* and a control group, with no supplemental probiotic) were formulated. A commercial dietary enzyme (Safizyme® GP 800) with β-glucanase activity was added to all six experimental groups. Birds were fed diets (starter: 7-21d, grower: 21-42 and finisher 42-49) based on NRC [36]. Experimental diets are shown in Table 1. All chicks had free access to feed and water during the experimental period. The Bioplus 2B® contains *Bacillus subtilis* and *Bacillus licheniformis*

Table 1: Ingredients and nutrient composition of the experimental diets

	Experimental diets (g/ 100 g diet)		
	Starter (1-21 d)	Grower (21-42 d)	Finisher (42-49 d)
Ingredients	g/ 100 g diet		
Barley	60.81	66.00	71.61
Soybean meal	30.11	24.25	19.00
Sunflower oil	5.31	6.29	6.02
DCP	1.11	0.74	0.70
Oyster shell	1.38	1.47	1.54
Salt	0.5	0.5	0.5
Vit & Min premix[1]	0.50	0.50	0.50
Lysine hydrochloride	0.08	0.12	0.04
DL-methionine	0.15	0.08	0.05
Safizyme® GP 800	0.05	0.05	0.05
Calculated analysis			
ME (Kcal Kg^{-1})	2800	2900	2900
Crude protein %	20.12	18.12	16.31
Calcium %	0.88	0.82	0.73
Available phosphate%	0.39	0.32	0.31
Lysine %	1.11	1.00	0.82
Methionine %	0.44	0.34	0.29
Met + Cys %	0.78	0.66	0.59

[1]The vitamin and mineral premix provide the following quantities per kilogram of diet: vitamin A, 10,000 IU (*all-trans*-retinal); cholecalciferol, 2,000 IU; vitamin E, 20 IU (*á*-tocopheryl); vitamin K3, 3.0 mg; riboflavin, 18.0 mg; niacin, 50 mg; D-calcium pantothenic acid, 24 mg; choline chloride, 450 mg; vitamin B12, 0.02 mg; folic acid, 3.0 mg; manganese, 110 mg; zinc, 100 mg; iron, 60 mg; copper, 10 mg; iodine, 100 mg; selenium, 0.2 mg; and antioxidant, 250 mg

(1.6×10^9 CFU/g for each one -1 g/ Kg). The birds and feed consumed were weighed on days 21, 42 and 49 to allow the calculation of live weight gain, feed intake and feed: gain ratio. Data were analyzed using the GLM procedures of SAS [37]. Means were separated for significance by Duncan's multiple range tests at significance level of $P < 0.05$ or as indicated.

RESULTS

Body weight, body weight gain, feed intake and feed: gain ratio is provided in Table 2 to 5. Body weight and body weight gain of chicks were not affected by dietary barley cultivar and probiotic. In present trail, the used probiotics had no beneficial effect on body weight gain.

Table 2: Body weight (g) of chicks fed barley-based diets (Sarurood-1, an Iranian rain-fall cultivar and Karoon-dar-Kavir, an Iranian irrigated cultivar) supplemented by two commercial probitics (Biosaf®, *Saccharomyces cerevisiae* and Bioplus 2B®, *Bacillus subtilis* and *Bacillus licheniformis*)

	Body weight (g)		
Days of age	Day 21	Day 42	Day 49
Barley Varieties (BV)			
KaroonDarKavir	569.16±58.71	1680.08±144.76	2043.75±167.89
Sarurood 1	583.43±52.68	1730.21±179.12	2104.44±217.61
Probiotic (P)			
Control	570.11±63.75	1728.51±177.97	2111.32±228.08
Lactobacillus	582.51±62.54	1704.37±162.26	2076.52±156.19
S. cervisea	576.26±41.63	1682.55±157.67	2034.46±200.43
Source of variation	P values		
Barley Varieties (BV)	0.473	0.388	0.379
Probiotic (P)	0.876	0.808	0.656
BV × P	0.895	0.922	0.962

Main effect means±SD

Table 3: Body weight gain (g /chick /day) of chicks fed barley-based diets (Sarurood-1, an Iranian rain-fall cultivar and Karoon-dar-Kavir, an Iranian irrigated cultivar) supplemented by two commercial probitics (Biosaf®, *Saccharomyces cerevisiae* and Bioplus 2B®, *Bacillus subtilis* and *Bacillus licheniformis*)

	Body weight gain (g/chick/day)			
Days of age	1-21	21-42	42-49	1-49
Barley Varieties (BV)				
KaroonDarKavir	25.44±2.23	52.27±4.97	56.10±8.54	38.81±4.59
Sarurood 1	25.85±2.50	53.64±6.57	56.66±8.63	40.25±3.97
Probiotic (P)				
Control	25.61±2.14	54.44±5.98	58.87±10.82	39.25±4.23
Lactobacillus	25.84±2.98	52.52±5.55	55.06±8.01	38.43±4.39
S. cervisea	25.49±1.97	51.91±5.95	55.45±6.47	40.91±4.35
Source of variation	P values			
Barley Varieties (BV)	0.631	0.501	0.886	0.404
Probiotic (P)	0.939	0.570	0.546	0.467
BV × P	0.993	0.888	0.668	0.953

Main effect means±SD

Table 4: Feed intake (g /chick /day) of chicks fed barley-based diets (Sarurood-1, an Iranian rain-fall cultivar and Karoon-dar-Kavir, an Iranian irrigated cultivar) supplemented by two commercial probitics (Biosaf®, *Saccharomyces cerevisiae* and Bioplus 2B®, *Bacillus subtilis* and *Bacillus licheniformis*)

	Feed intake (g/chick/day)			
Days of age	1-21	21-42	42-49	1-49
Barley Varieties (BV)				
KaroonDarKavir	36.95±2.57	104.60±9.33	$124.75±16.54^b$	76.20±5.60
Sarurood 1	37.33+3.72	102.31±13.63	$135.65±23.80^a$	76.57±7.84
Probiotic (P)				
Control	37.11±3.52	107.11±12.23	$138.64±23.46^a$	79.24±7.58
Lactobacillus	37.25±2.48	102.67±11.46	$129.34±21.70^b$	75.98±5.94
S. cervisea	37.14±3.64	100.99±11.01	$122.42±15.12^b$	74.15±6.04
Source of variation	P values			
Barley Varieties (BV)	0.706	0.622	0.047	0.823
Probiotic (P)	0.994	0.471	0.050	0.063
BV × P	0.927	0.938	0.853	0.986

Main effect means±SD, $^{a-b}$ Means within columns with different superscript are significantly different ($P<0.05$)

Table 5: Feed conversion ratio (g:g) of chicks fed barley-based diets (Sarurood-1, an Iranian rain-fall cultivar and Karoon-dar-Kavir, an Iranian irrigated cultivar) supplemented by two commercial probitics (Biosaf®, *Saccharomyces cerevisiae* and Bioplus 2B®, *Bacillus subtilis* and *Bacillus licheniformis*)

	Feed conversion ratio (g:g)			
Days of age	1-21	21-42	42-49	1-49
Barley Varieties (BV)				
KaroonDarKavir	1.46±0.11	2.00±0.08[a]	2.25±0.37	2.09±0.34
Sarurood 1	1.45±0.14	1.88±0.13[b]	2.41±0.39	2.02±0.28
Probiotic (P)				
Control	1.46±0.11	1.92±0.16	2.38±0.41	2.02±0.12
Lactobacillus	1.45±0.14	1.95±0.08	2.37±0.37	2.07±0.28
S. cervisea	1.46±0.14	1.95±0.12	2.25±0.40	2.07±0.47
Source of variation	P values			
Barley Varieties (BV)	0.770	0.001	0.067	0.518
Probiotic (P)	0.984	0.628	0.732	0.900
BV × P	0.887	0.448	0.320	0.424

Main effect means±SD, [a-b] Means within columns with different superscript are significantly different (P<0.05)

The experimental treatments affected feed intake of chicks during the finishing period. Birds fed diet included Sarurood-1 barley cultivar consumed more feed compared to birds fed Karoon-dar-kavir included diets (P<0.05). The used commercial probiotics decreased feed intake of chicks during the finishing period.

CONCLUSION AND DISCUSSION

In this investigation, dietary probitics decreased feed intake in broilers during the finishing period that is in agreement with other study in which supplementation with a *Bacillus*-based direct fed microbe was shown to decrease feed intake in poultry [38]. Probiotics in the present study did not have any beneficial effect on body weight gain of birds; while, Yu *et al*. [39] reported that the transformed *Latobacillus reuteri* Pg4 can survive and secrete β-glucanase in the broiler gastrointestine tract and decrease digesta viscosity and enhance weight gain in birds fed a barley-based diet. In addition, Chen *et al*. [40] reported that fermented feed *by Bacillus subtilis* and *Saccharomyces cerevisiae* increased gross energy availability, BW and feed intake in chickens. Matur *et al*. [41] reported that addition of 1 g/kg of *S. cerevisiae* extract reduces the toxic effects of aflatoxin on pancreatic lipase and chymotrypsin activity in laying breeder hens. The variance in dietary probiotic effect on bird's performance may be in part due to variety of the used microbes or the duration or dose of usage in diet.

Based on the data of this experiment, it can be concluded that probitics may have beneficial effect on broilers' feed efficiency. In addition, dietary barley varieties could influence on feed intake. There was no dietary barley cultivar and probiotic interaction on performance of birds in the present study.

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